REMARKS

Claims 1-3 are currently pending in the subject application and are presented to the Examiner for further prosecution on the merits.

A. Introduction

Claims 1-3 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,376,355 to Yoon et al. ("the Yoon et al. reference") in view of U.S. Patent No. 6,143,645 to Hsu et al. ("the Hsu et al. reference").

B. Asserted Rejections Under 35 U.S.C. § 103(a)

In the outstanding Office Action, the Examiner rejected claims 1-3 under 35 U.S.C. § 103(a) as being unpatentable over the Yoon et al. reference in view of the Hsu et al. reference.

This rejection is respectfully traversed, as there is no motive to combine the references as suggested by the Examiner, and further, as the combination of cited prior art references does not teach each and every element of the invention as claimed in claims 1-3.

In rejecting claims 1-3, the Examiner states, in part:

> Yoon et al. does not specifically show depositing the metal or metal alloy for inhibiting aluminum migration on the anti-nucleation layer. However, Yoon et al. recites, as well known in the art, the necessity to avoid aluminum diffusion (col. 1, lines 33-40). In addition, Hsu et al. discloses depositing a thin diffusion barrier (inhibiting aluminum migration) layer (510) on the barrier metal except in the recess region (Fig. 2B, col. 1, lines 45-50, col. 3, lines 24-32, col. 4, lines 35-45, col. 6, lines 45-50). Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify [the] Yoon et al. reference by including the metal or metal alloy for inhibiting aluminum migration as taught [by] Hsu et al. in order to prevent junction spiking and electromigration (Hsu et al., col. 1, lines 59-65, col. 2, lines 47-50).

The Office Action of July 15, 2003, at p. 3.

In the following remarks, it is assumed that the "metal or metal alloy" referred to by the Examiner as cited above pertains to the TiN diffusion barrier layer of the Hsu et al. reference. Applicants respectfully assert that there is no motivation to combine the "thin diffusion barrier" layer or "metal or metal alloy" for "inhibiting aluminum migration" of the Hsu et al. reference with the devices of the Yoon et al. reference, as the devices of the Yoon et al. reference already include a "thin diffusion barrier" layer that is analogous to the TiN diffusion barrier layer of the Hsu et al. reference. Applicants assert that as a result, incorporating the "thin diffusion barrier" layer as it is taught by the Hsu et al. reference into the devices as taught by the Yoon et al. reference would not result in any substantive change to the devices of the Yoon et al. reference, or the methods of making such devices.

The thin diffusion barrier layer 510 referred to by the Examiner as "inhibiting aluminum migration" is described in the Hsu et al. reference as being formed on "the wetting layer 500," which is a silicon-rich titanium silicide layer or another layer for lowering a temperature at which aluminum melts, and is deposited on a dielectric layer having a contact hole formed therein. The thin diffusion barrier layer 510 is further described as serving to "prevent diffusion of the wetting agent 500 into the metal 520 in the field," and as being formed of TiN or SiN. *See the Hsu et al. reference at col. 3, lines 15-29 and col. 4, lines 51-59*

The Yoon et al. reference teaches forming an ohmic titanium layer 107 on a dielectric layer formed on a substrate, the dielectric layer having a contact hole formed therein, so that the ohmic titanium layer 107 reacts with silicon atoms in an underlying portion of the substrate, i.e., impurity layer 103, to form a silicide layer. *See the Yoon et al. reference at col. 4, line 6 – col. 5, line 29.*

Therefore, the ohmic titanium layer 107 is a silicon-rich titanium silicide layer that is deposited on a dielectric layer having a contact hole formed therein, similar to the wetting layer 500 of the Hsu et al. reference.

The Yoon et al. reference goes on to teach forming a barrier metal layer 109 of TiN on the ohmic titanium layer 107 for suppressing diffusion of silicon atoms in the impurity layer 103 and aluminum atoms in a metal layer to be formed later. *See the Yoon et al. reference at col. 5, lines 27-35.*

Therefore, the TiN barrier metal layer 109 of the Yoon et al. reference is similar to the TiN thin diffusion barrier layer 510 for preventing diffusion of the wetting agent into aluminum of the Hsu et al. reference, which is asserted as "inhibiting aluminum migration" in the outstanding rejection of claims 1-3.

The Yoon et al. reference then teaches forming a copper layer on the barrier metal layer and in the contact hole, forming an anti-nucleation layer (ANL) of Al_2O_3, TiO_2 or Ta_2O_5 on the copper layer outside the contact hole, and forming aluminum or aluminum and copper in the contact hole only, and reflowing the aluminum. *See the Yoon et al. reference at col. 5, line 44 – col. 9, line 6.*

As noted in the outstanding Office Action, the Yoon et al. reference does not teach or suggest depositing a metal or metal alloy for inhibiting aluminum migration on an anti-nucleation layer as claimed in claim 1 of the subject application. Further, the Hsu et al. reference teaches only deposition of a metal or metal alloy for filling the contact hole, and teaches only deposition of such a metal or metal alloy on the diffusion barrier layer 510 or directly on the wetting layer 500. In no case does the Hsu et al. reference teach depositing selectively an anti-nucleation layer on a barrier metal except in a recess region, depositing a CVD-Al layer on the

barrier metal in the recess region, depositing a metal or a metal alloy for inhibiting aluminum migration on the anti-nucleation layer and the barrier metal except in the recess region, and depositing a PVD-Al layer and reflowing the PVD-Al layer, as claimed in claim 1 of the subject application.

Therefore, as illustrated above, the barrier metal layer 109 formed on the ohmic titanium layer 107, or titanium-rich silicide layer, in the Yoon et al. reference is analogous to the thin diffusion barrier layer 510 formed on the titanium-rich silicide wetting layer 500 of the Hsu et al. reference. Accordingly, as previously stated, applicants respectfully submit that there is no motivation to combine the "thin diffusion barrier" layer for "inhibiting aluminum migration" that is formed on the silicon-rich titanium silicide wetting layer of the Hsu reference et al. reference with the devices of the Yoon et al. reference, as the devices of the Yoon et al. reference already include a "thin diffusion barrier" layer that is formed on a silicon-rich titanium silicide layer for inhibiting aluminum migration. As a result, incorporating the "thin diffusion barrier" layer as taught by the Hsu et al. reference into the devices as taught by the Yoon et al. reference would not result in any substantive change to the devices of the Yoon et al. reference, or the methods of making such devices.

Further, because neither the Hsu et al. reference nor the Yoon et al. reference teaches or suggests depositing a metal or metal alloy for inhibiting aluminum migration on an anti-nucleation layer and a barrier metal except in a recess region, as claimed in claim 1 of the subject application, it is respectfully submitted that combining the teachings of the cited prior art references as suggested by the Examiner in the outstanding Office Action does not result in the present invention as claimed in claim 1.

Accordingly, claim 1 and claims 2-3, which depend from claim 1, are believed to be in condition for allowance, and a notice to such effect is respectfully requested.

C. Conclusion

Since none of the cited prior art references, alone or in combination, anticipate or render obvious claims 1-3, it is respectfully submitted that these claims are in condition for allowance, and a notice to such effect is respectfully requested.

If the Examiner believes that additional discussions or information might advance the prosecution of the instant application, the Examiner is invited to contact the undersigned at the telephone number listed below to expedite resolution of any outstanding issues.

In view of the foregoing remarks, reconsideration of this application is respectfully requested, and an early and favorable further action upon all pending claims is hereby requested.

Respectfully submitted,

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